



Simulating sub-critical transverse cracking and delamination in blocked un-notched specimens

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This presentation covers mostly the work published in:

Chen, Pinho, Carvalho, Baiz, Tay. Modelling the tensile failure of composites with the floating node method. *Computer Methods in Applied Mechanics and Engineering*, 308: 414-442, 2016

Outline

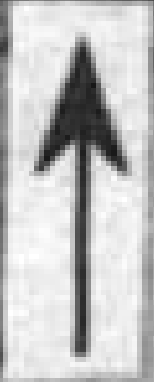
Numerical difficulty:
Matrix crack \rightarrow delamination



Un-notched Tension: $[45_4/90_4/-45_4/0_4]_s$



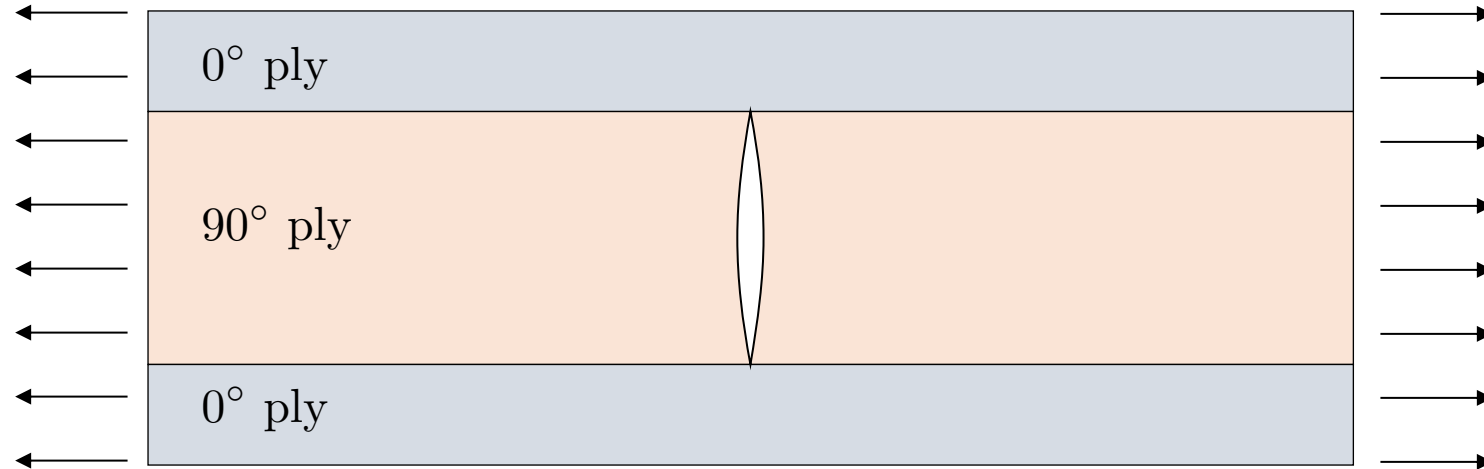
Numerical difficulty:
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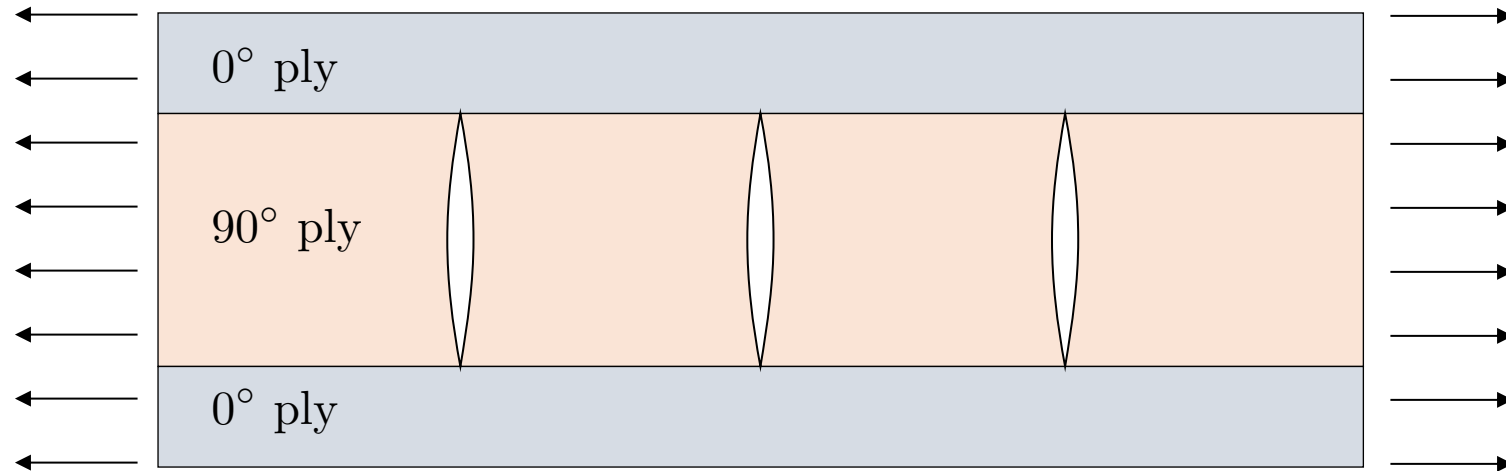
Matrix cracking and delamination



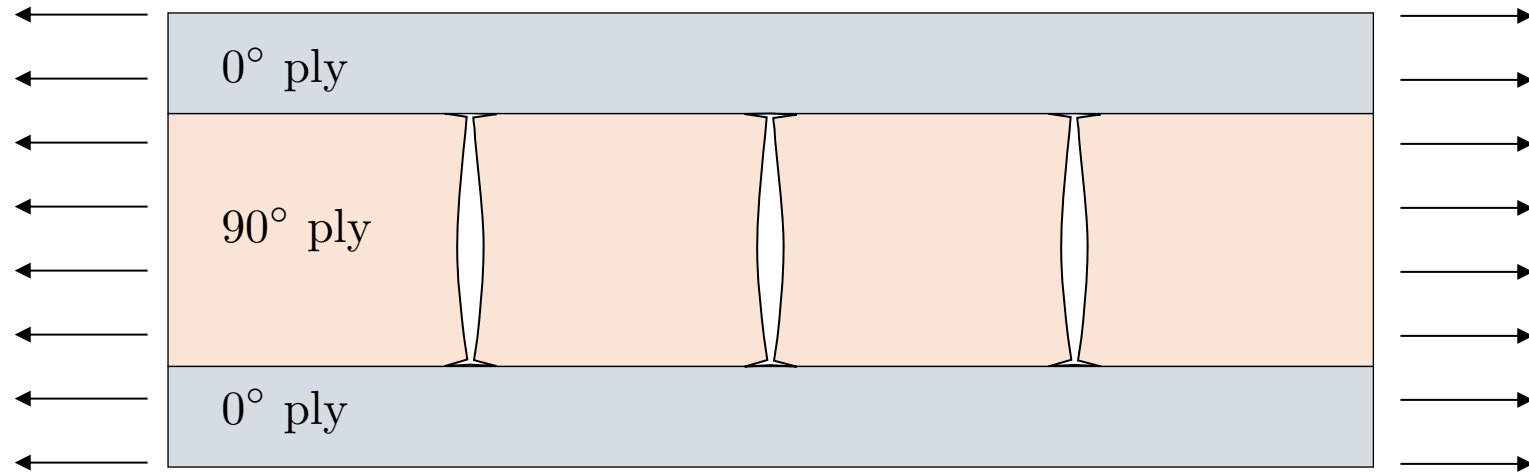
Matrix cracking and delamination



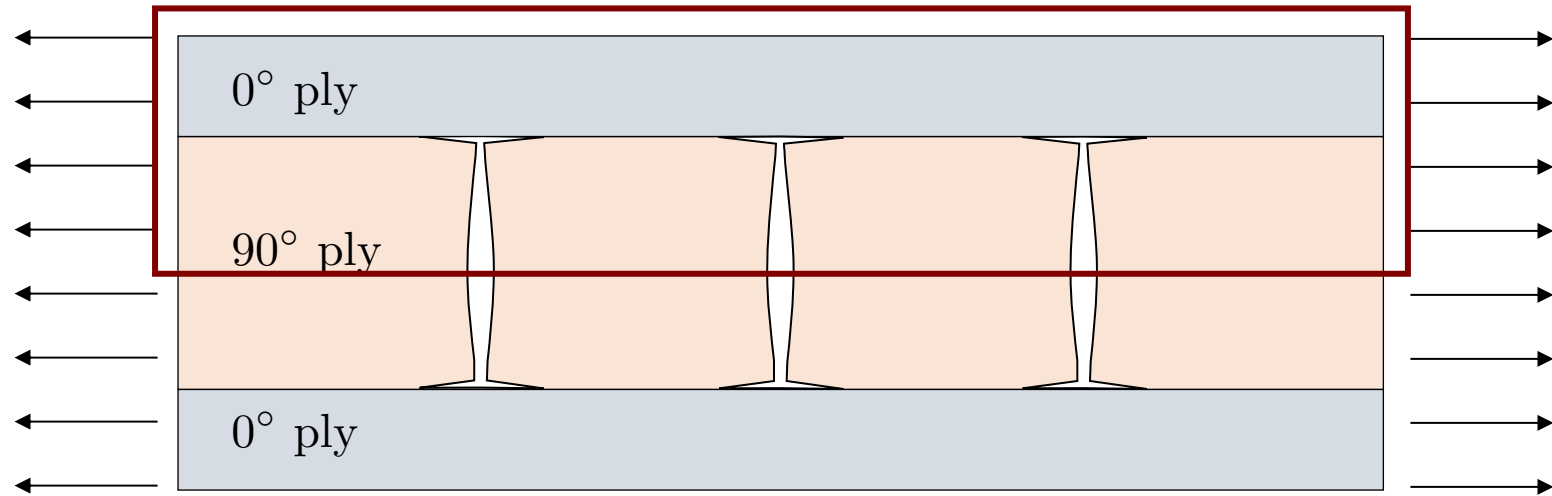
Matrix cracking and delamination



Matrix cracking and delamination

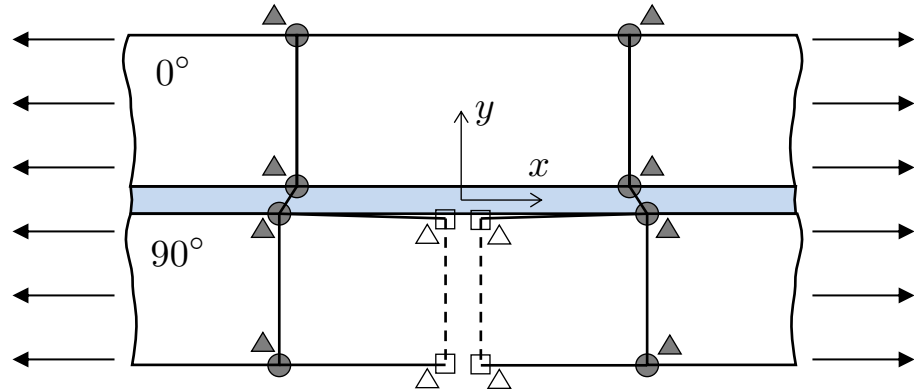


Matrix cracking and delamination

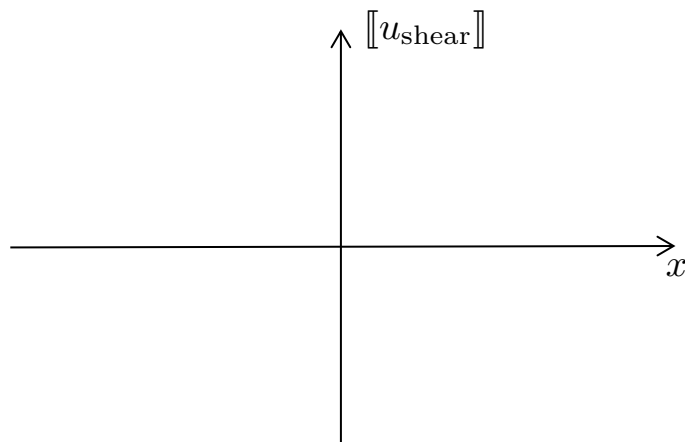
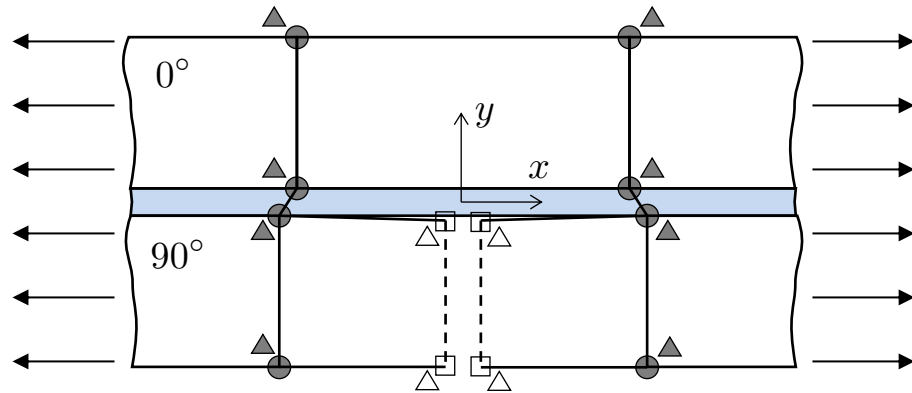


On the suitability of PNM + CZM

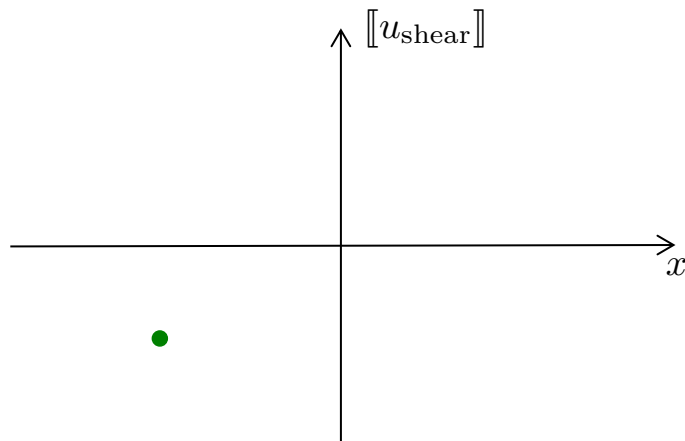
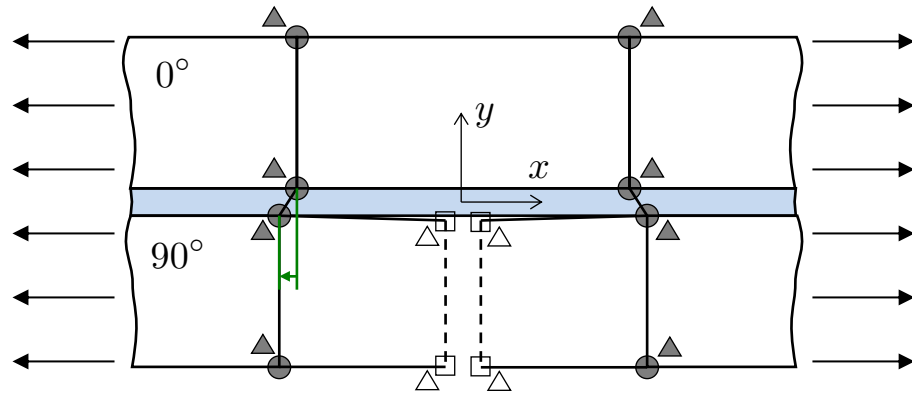
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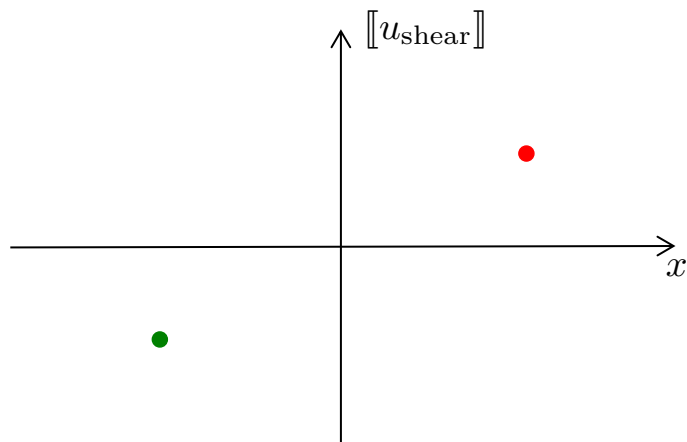
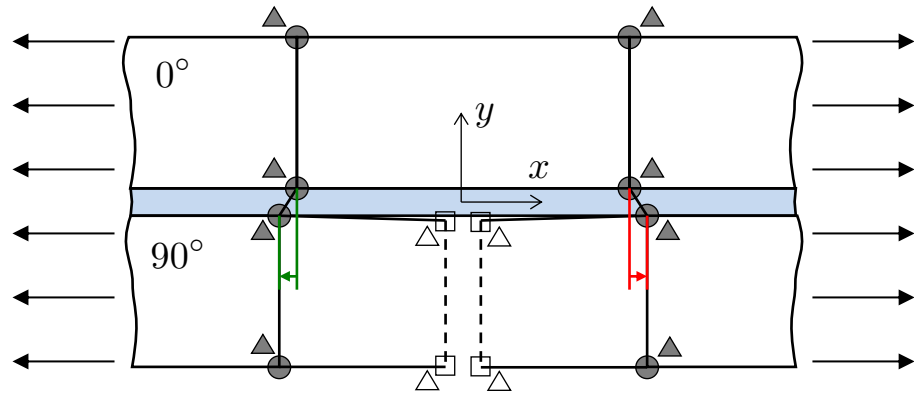
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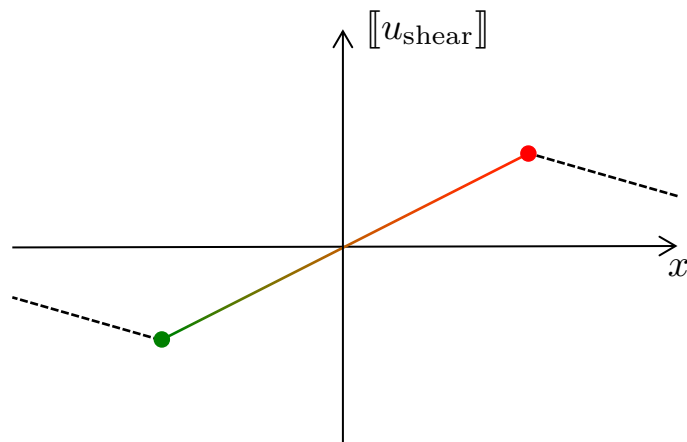
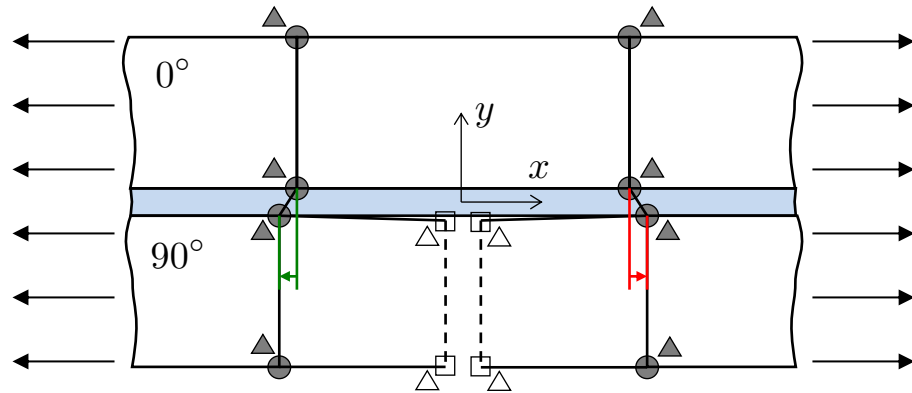
On the suitability of PNM + CZM



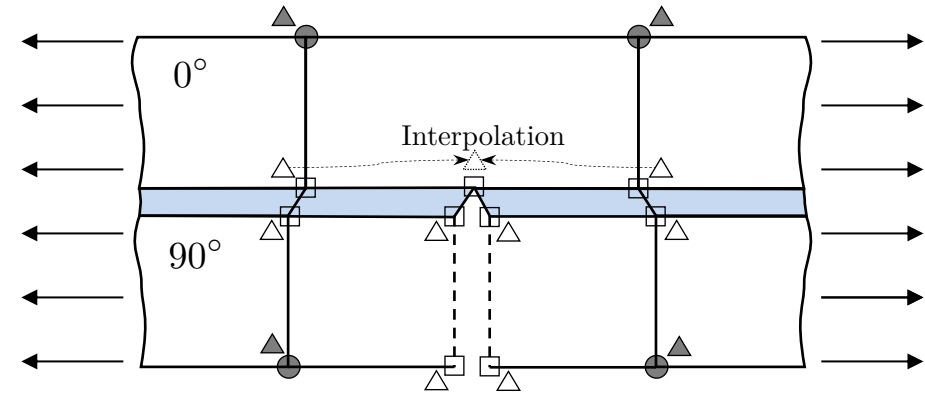
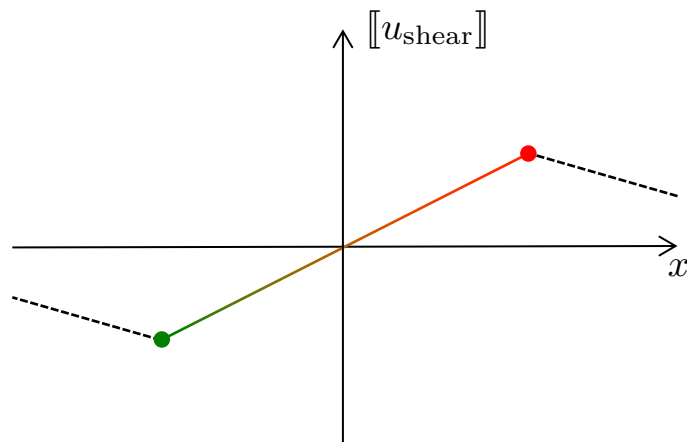
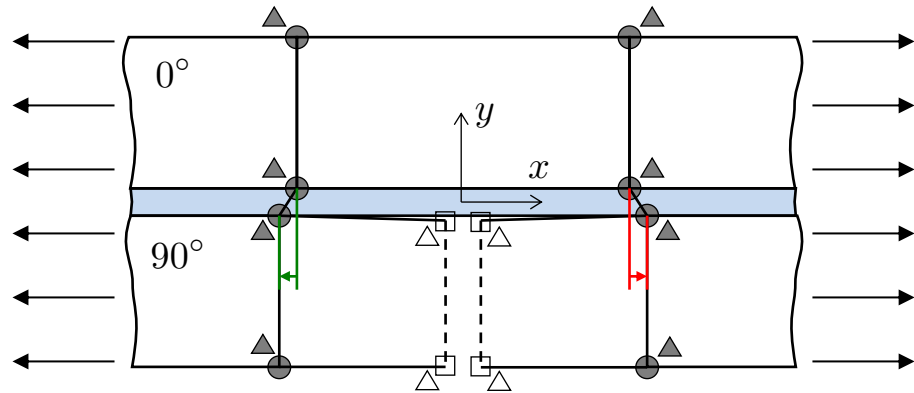
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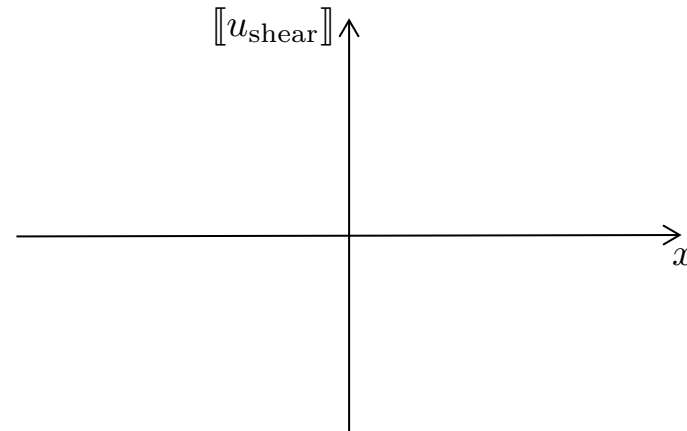
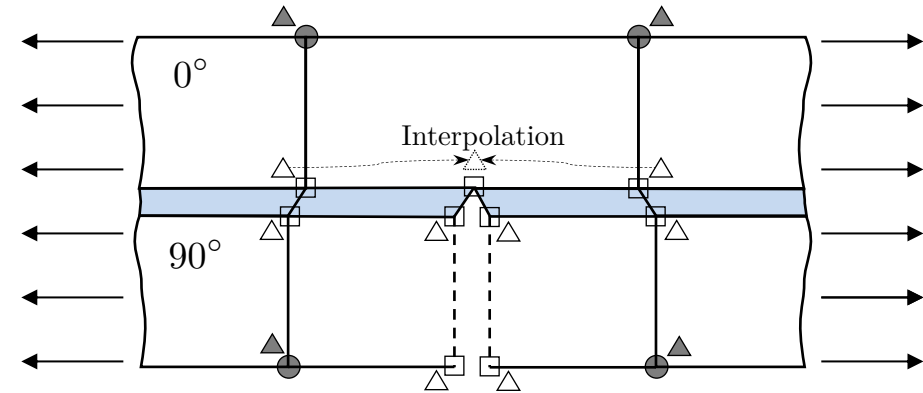
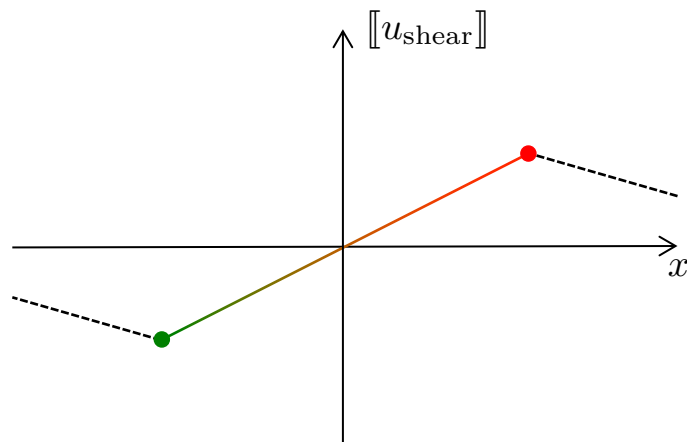
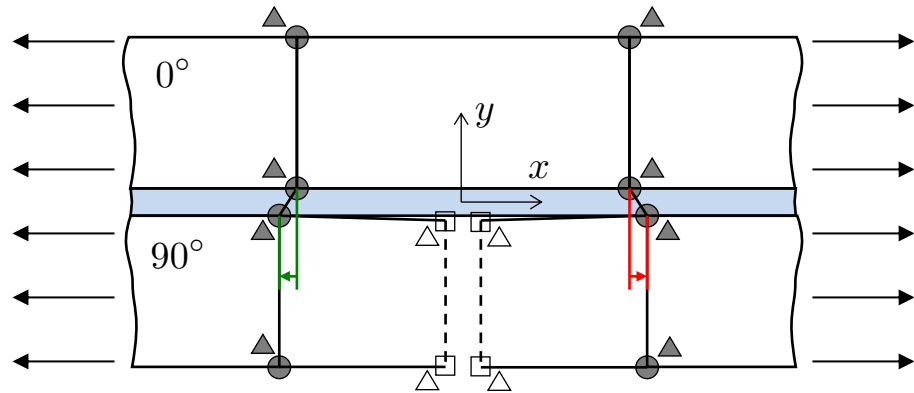
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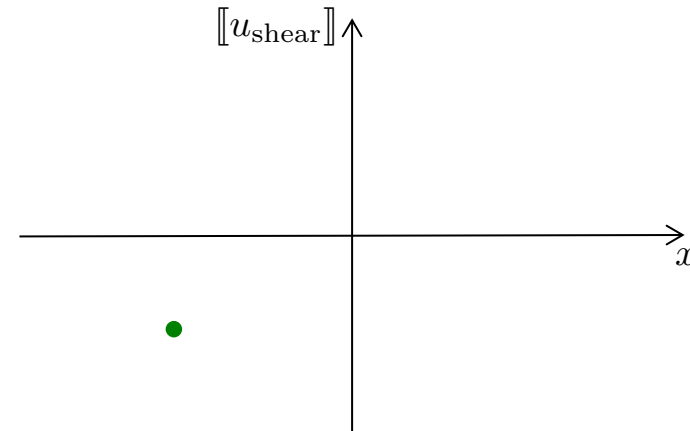
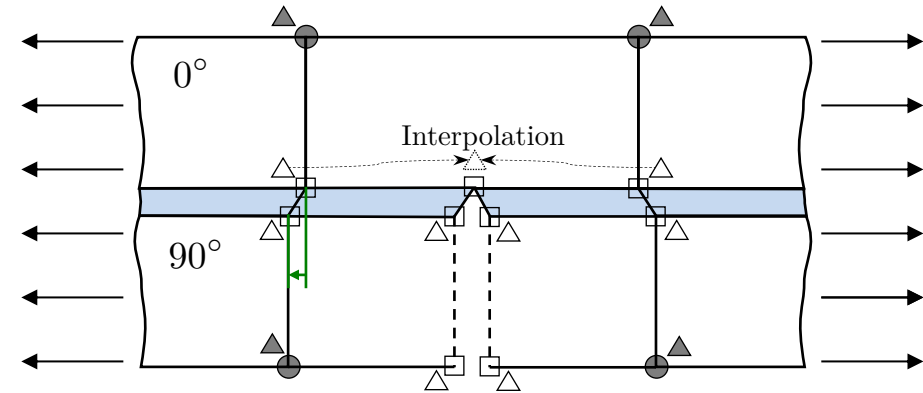
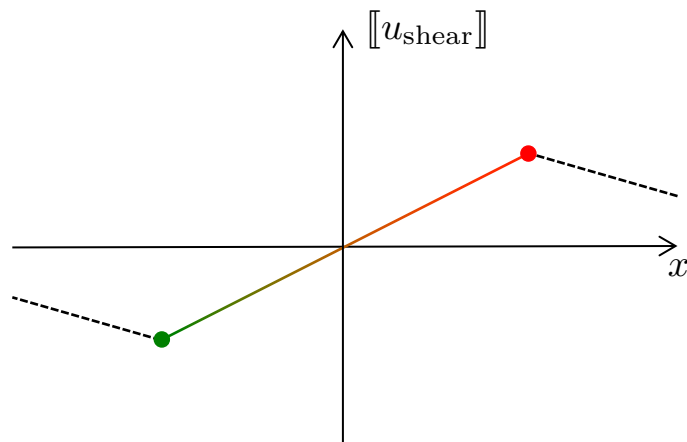
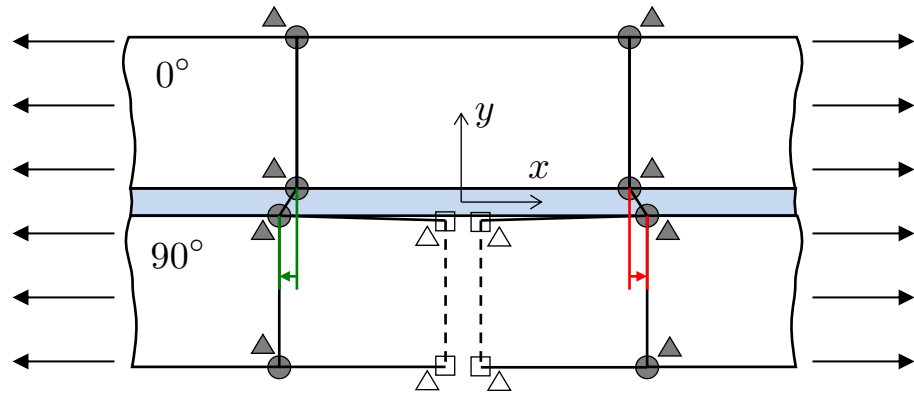
On the suitability of PNM + CZM



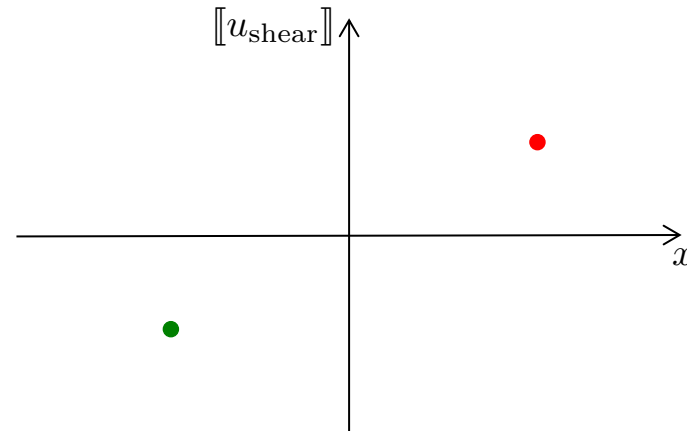
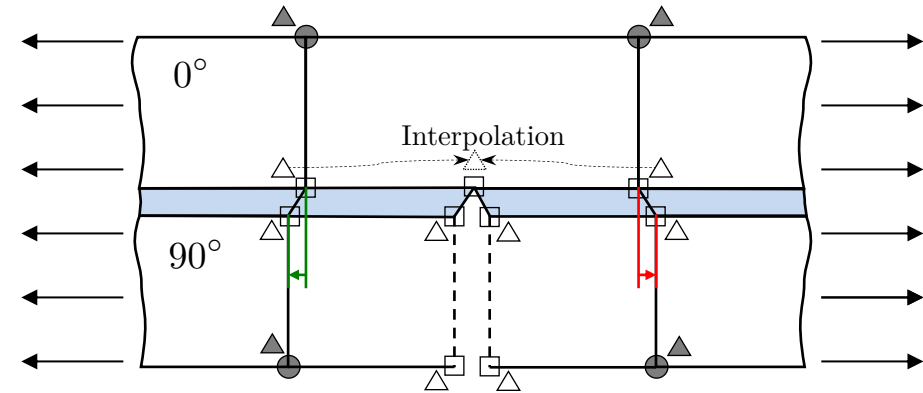
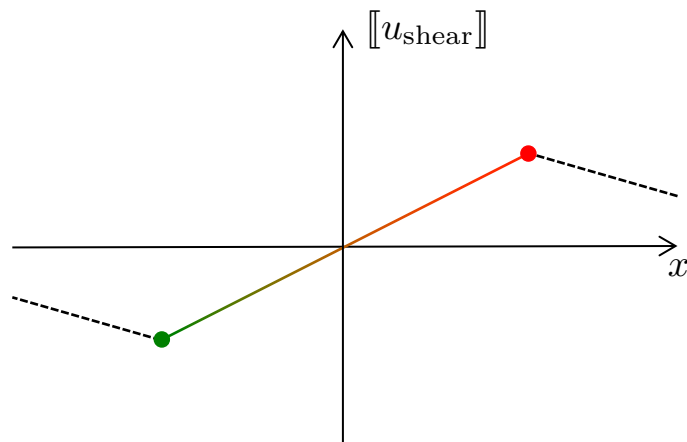
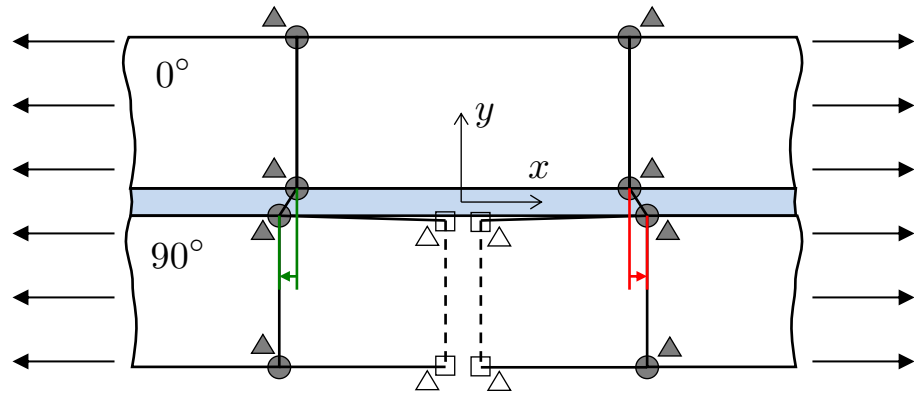
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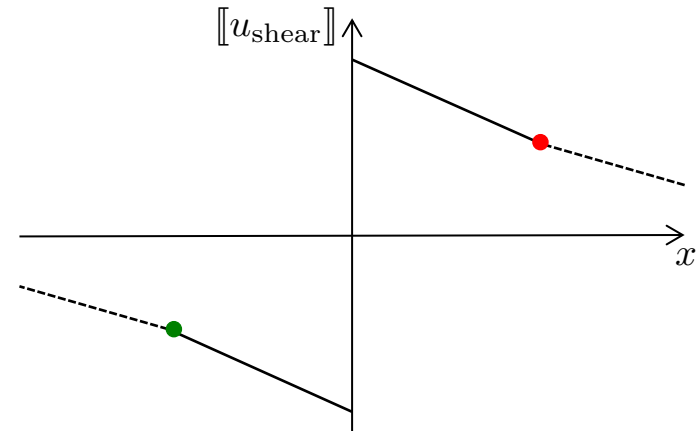
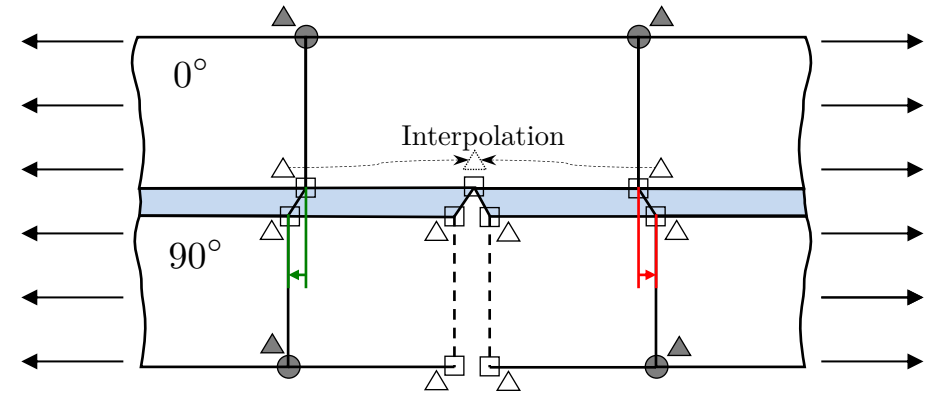
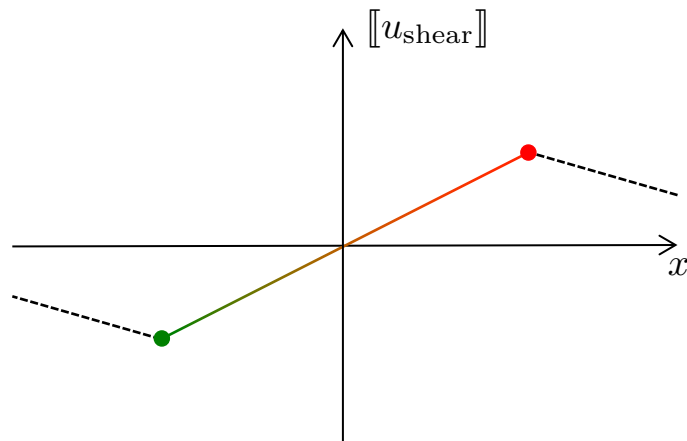
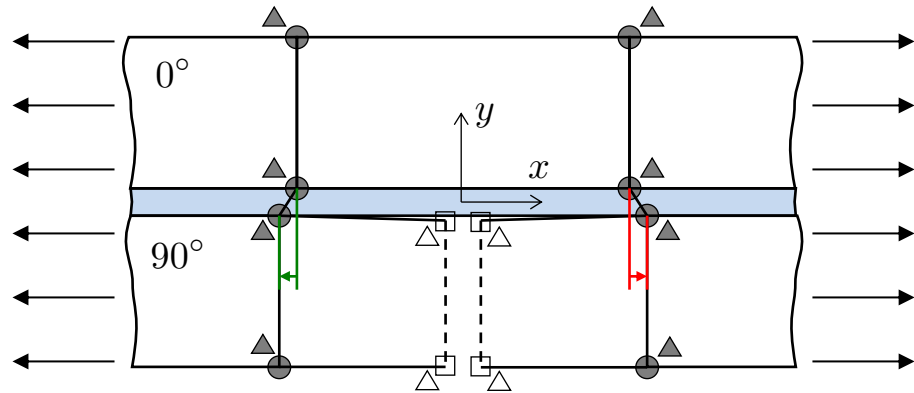
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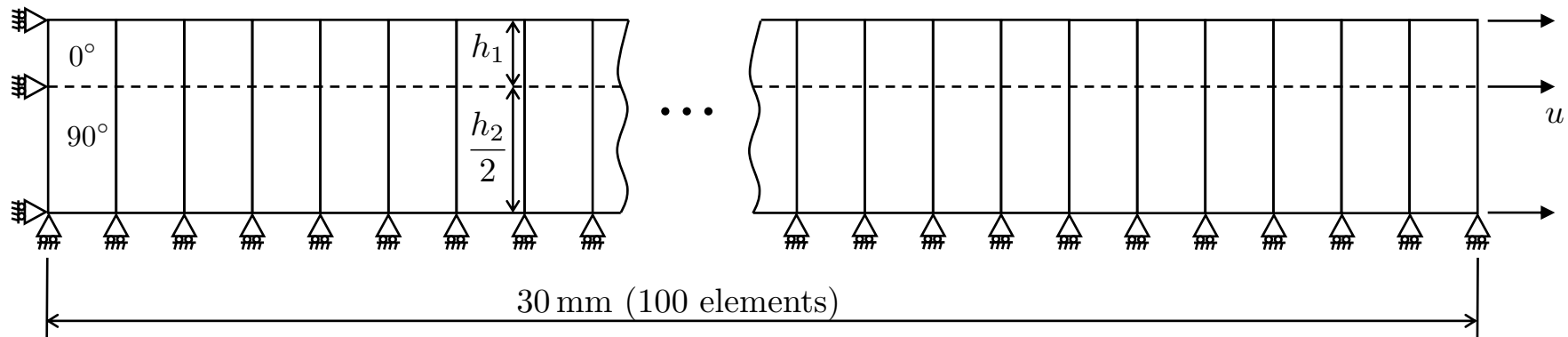
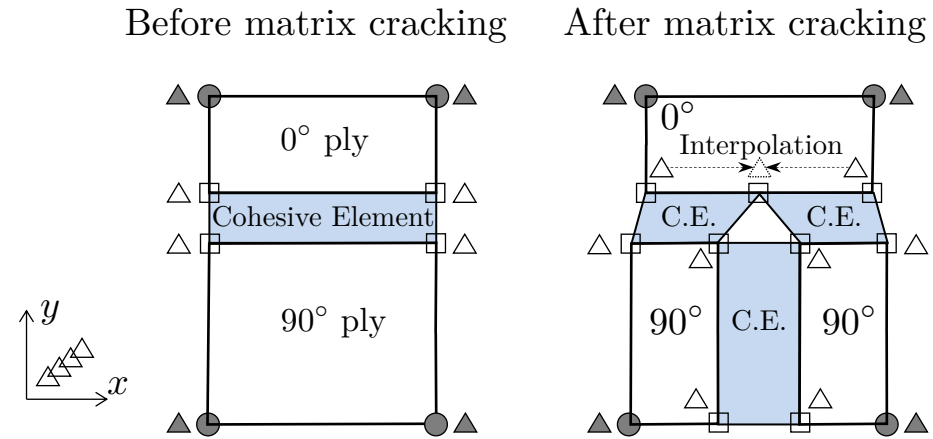
On the suitability of PNM + CZM



On the suitability of PNM + CZM

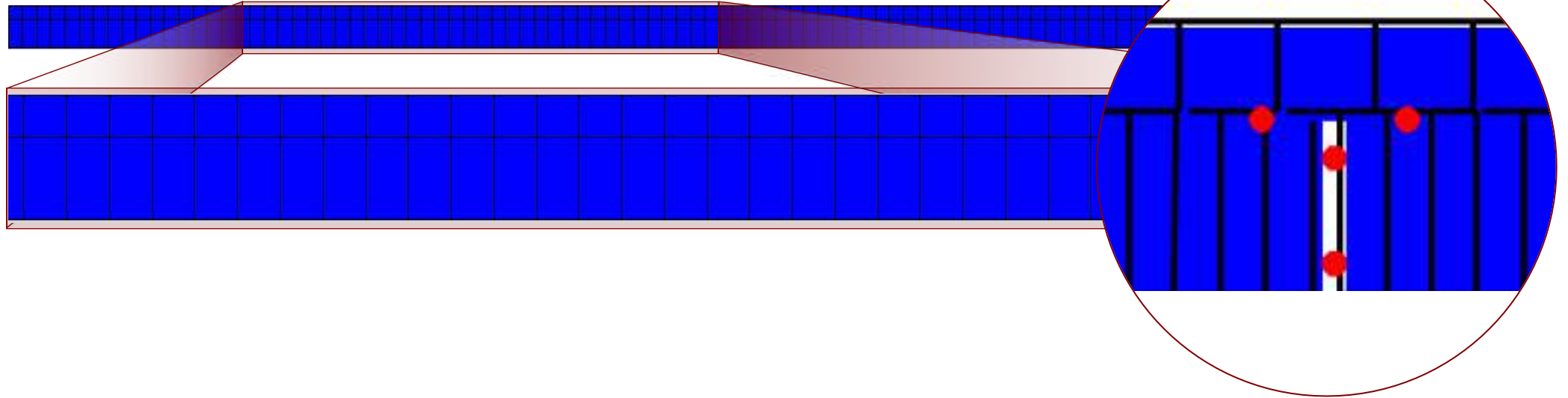


Our floating element and FE model

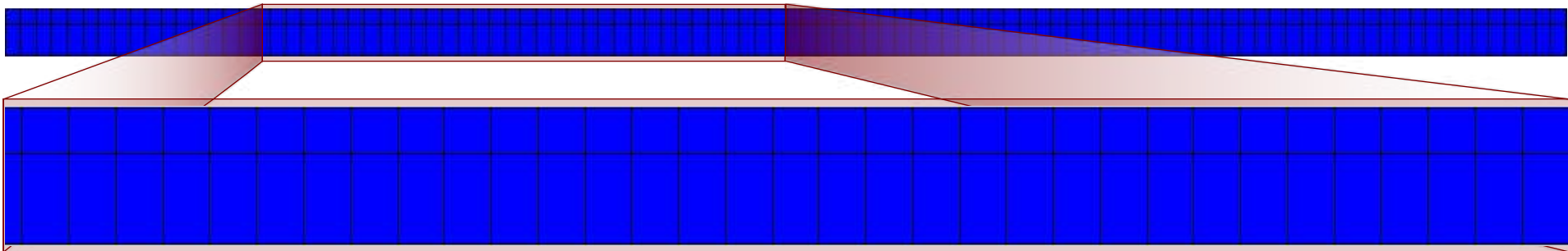


Progressive cracking

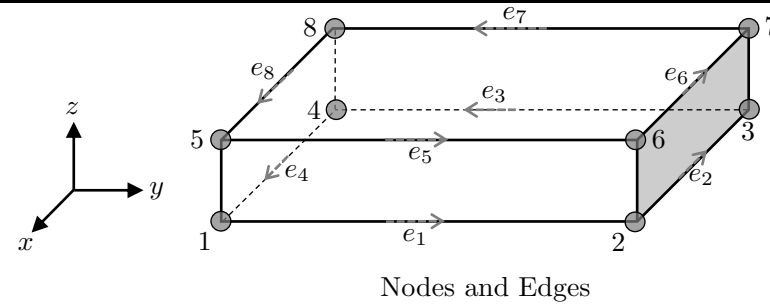
Phantom node method + CZM (non-matching mesh)



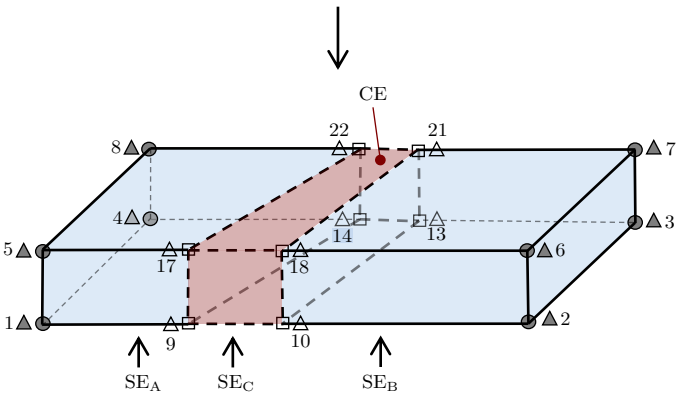
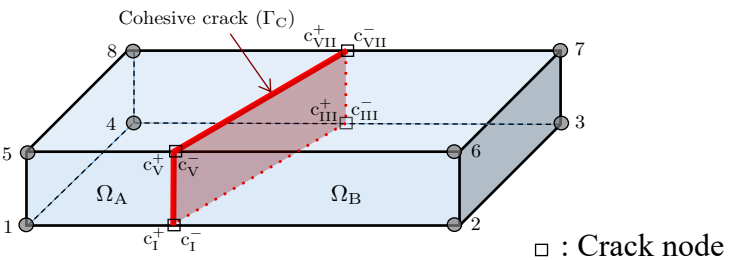
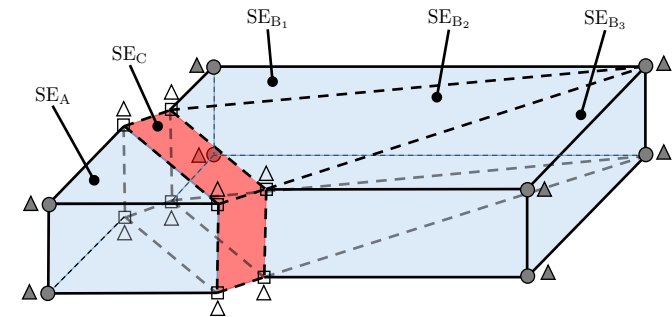
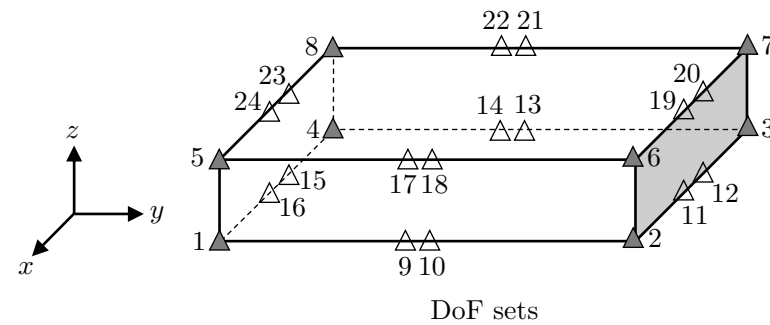
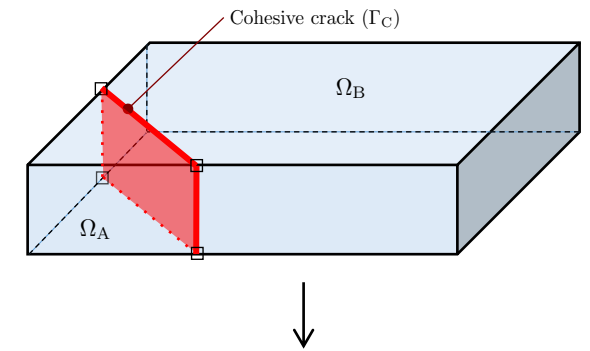
Floating node method



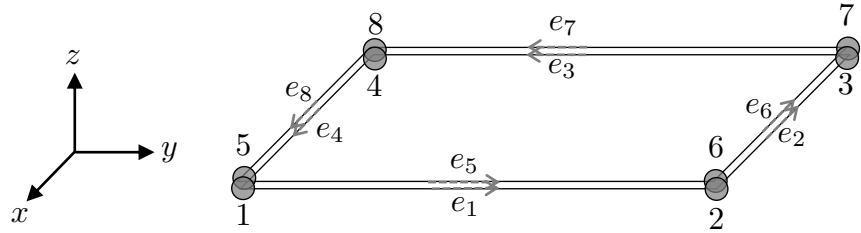
3D FNM: Ply element



- : Node
- e_i : Edge i
- ▲ : Nodal DoF
- △ : Floating DoF

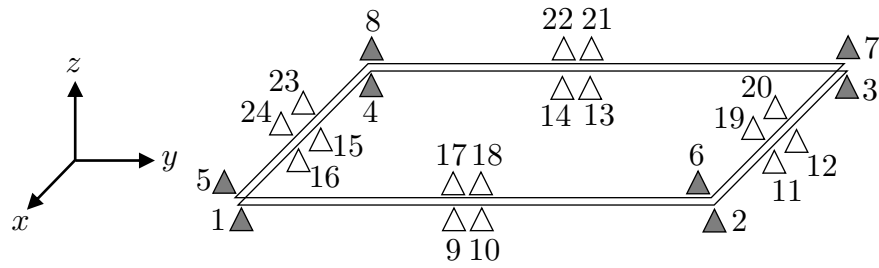


3D FNM: Cohesive Element

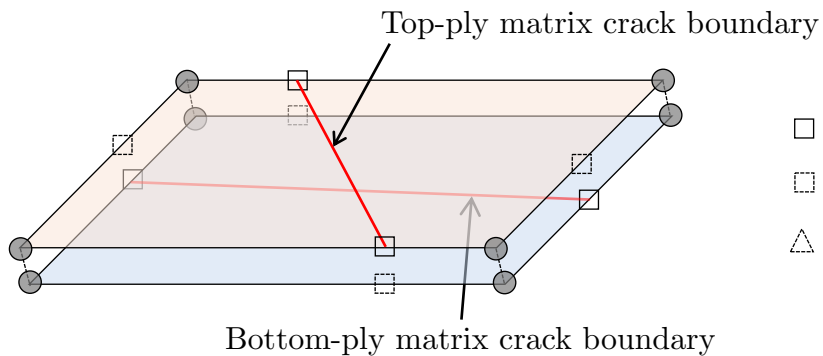


Nodes and Edges

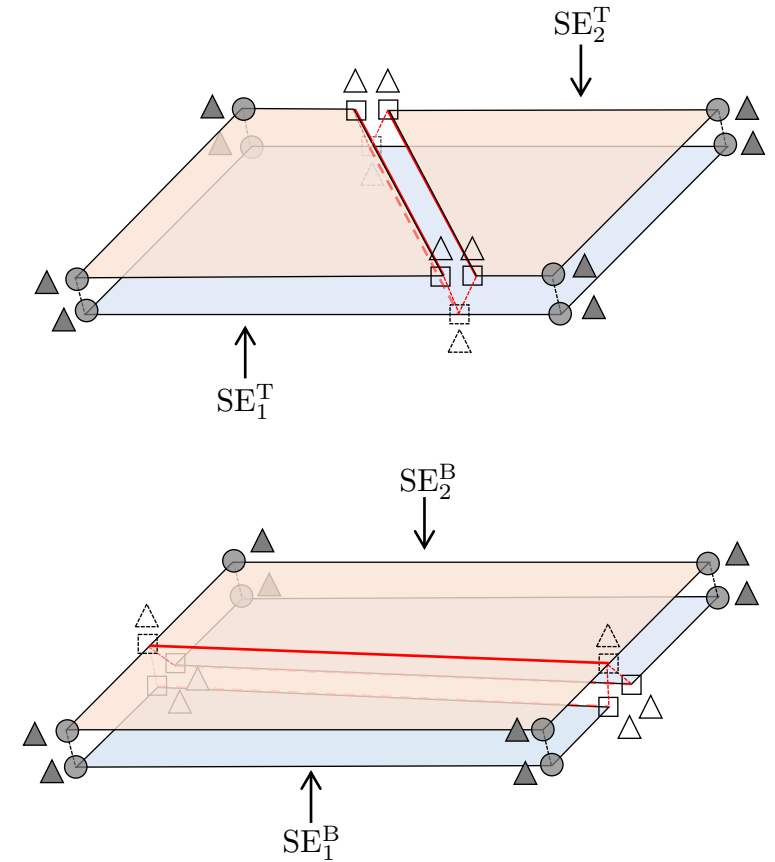
- : Node
- e_i : Edge i
- ▲ : Nodal DoF
- △ : Floating DoF



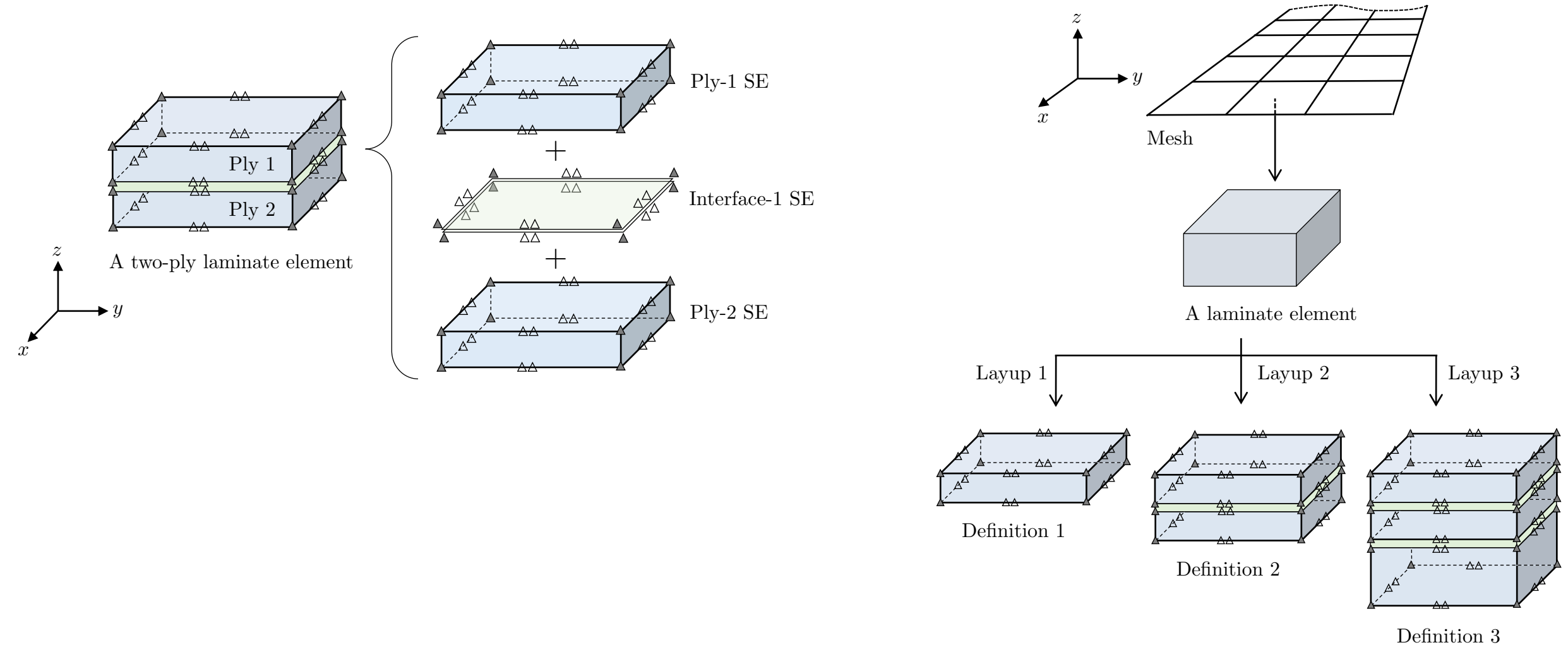
DoF sets



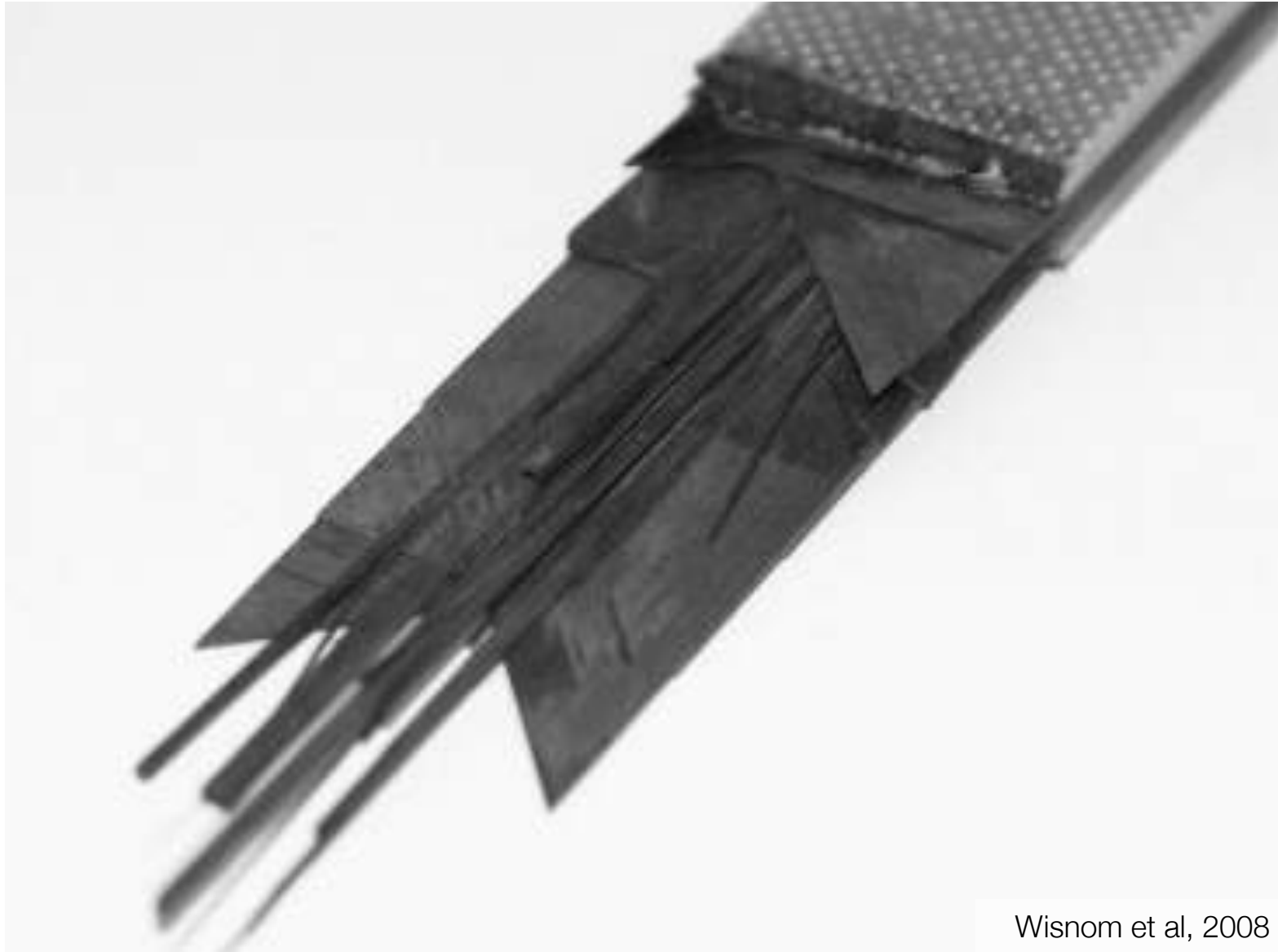
- : Crack node
- ◻ : Auxiliary node
- △ : Auxiliary DoF



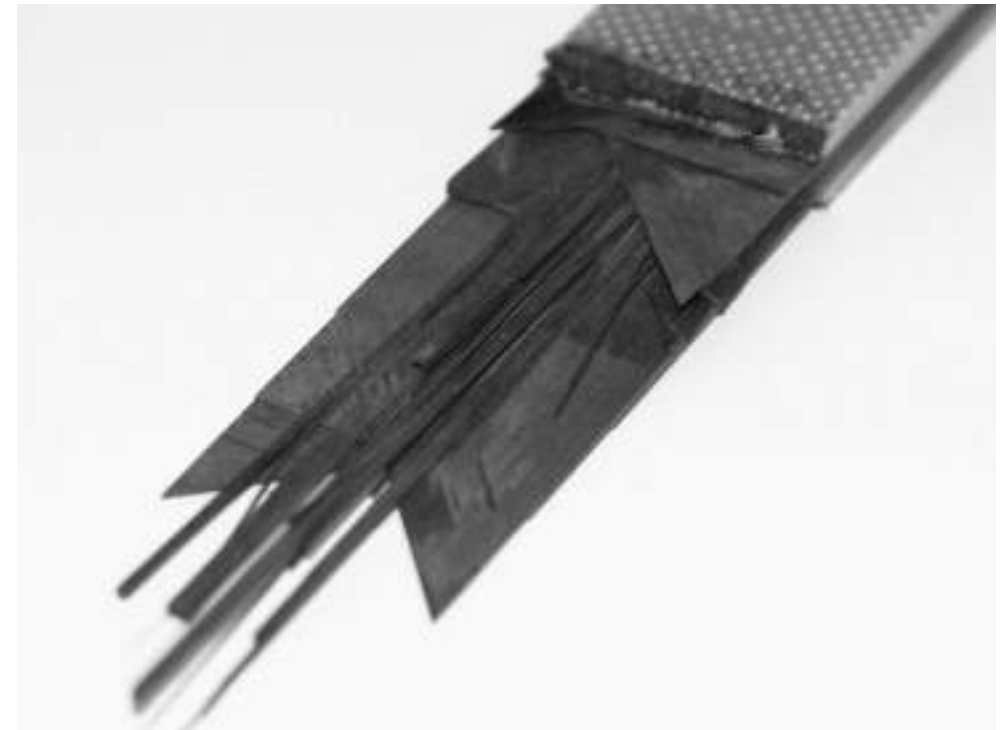
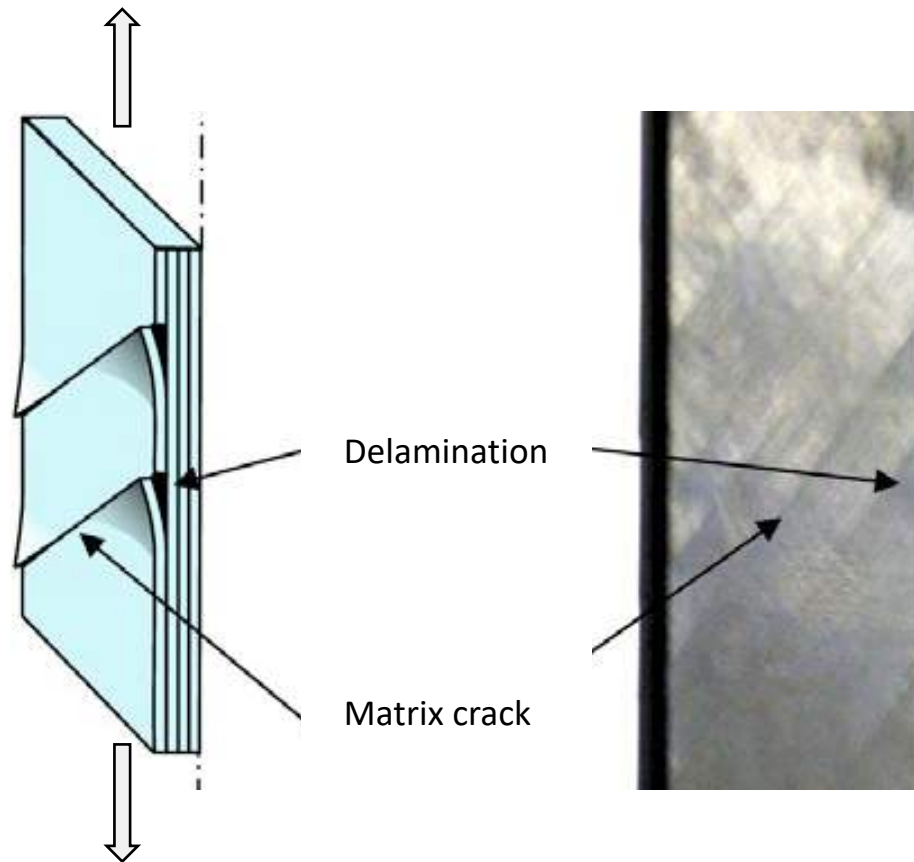
3D Laminate Element



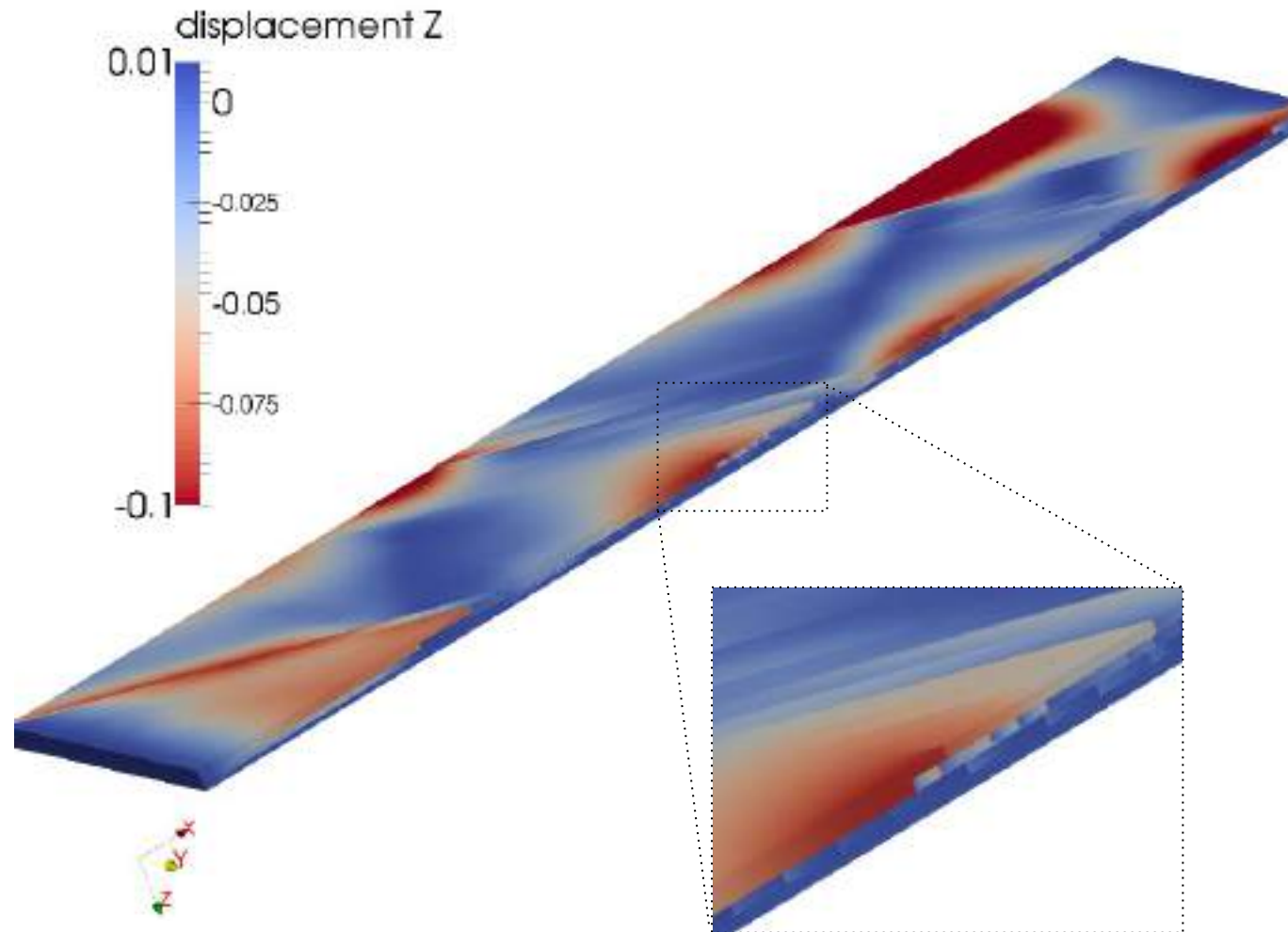
Un-notched Tension: $[45_4/90_4/-45_4/0_4]_s$



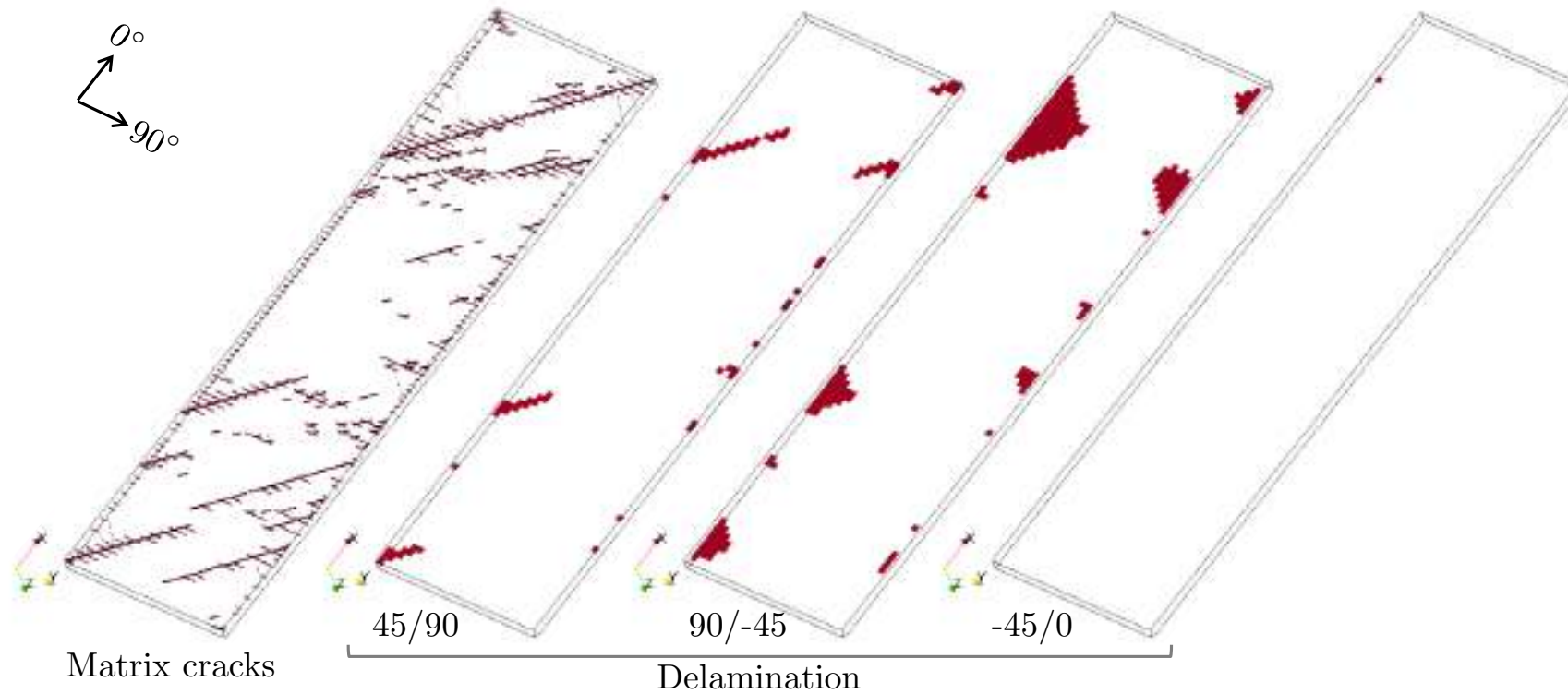
Un-notched Tension: $[45_4/90_4/-45_4/0_4]_s$



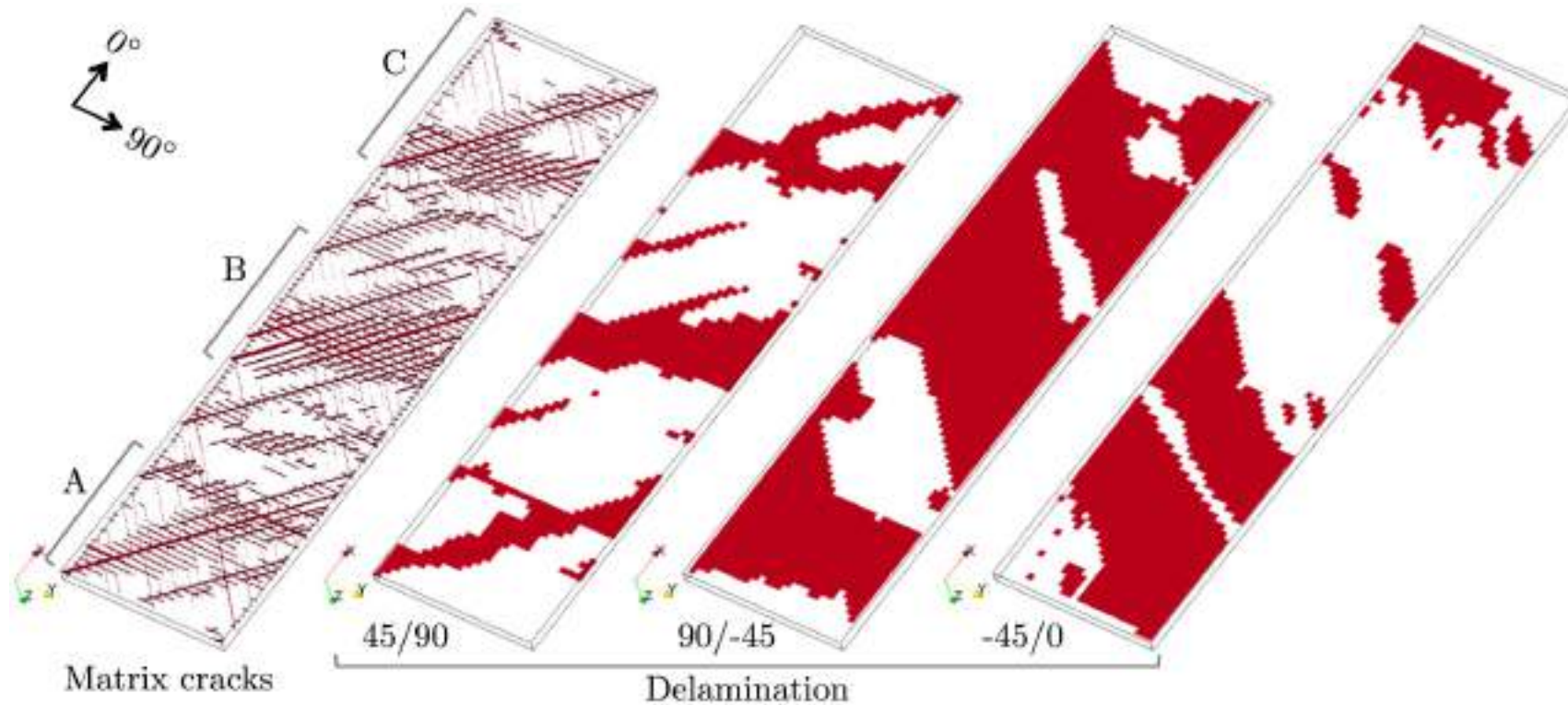
Un-notched Tension: Peel-off



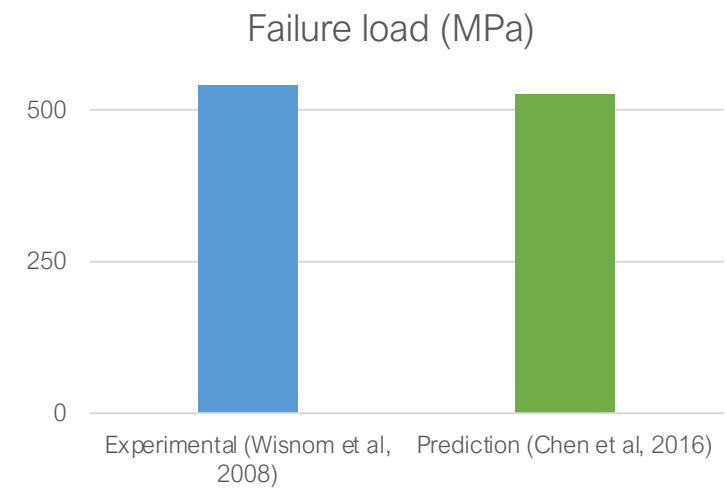
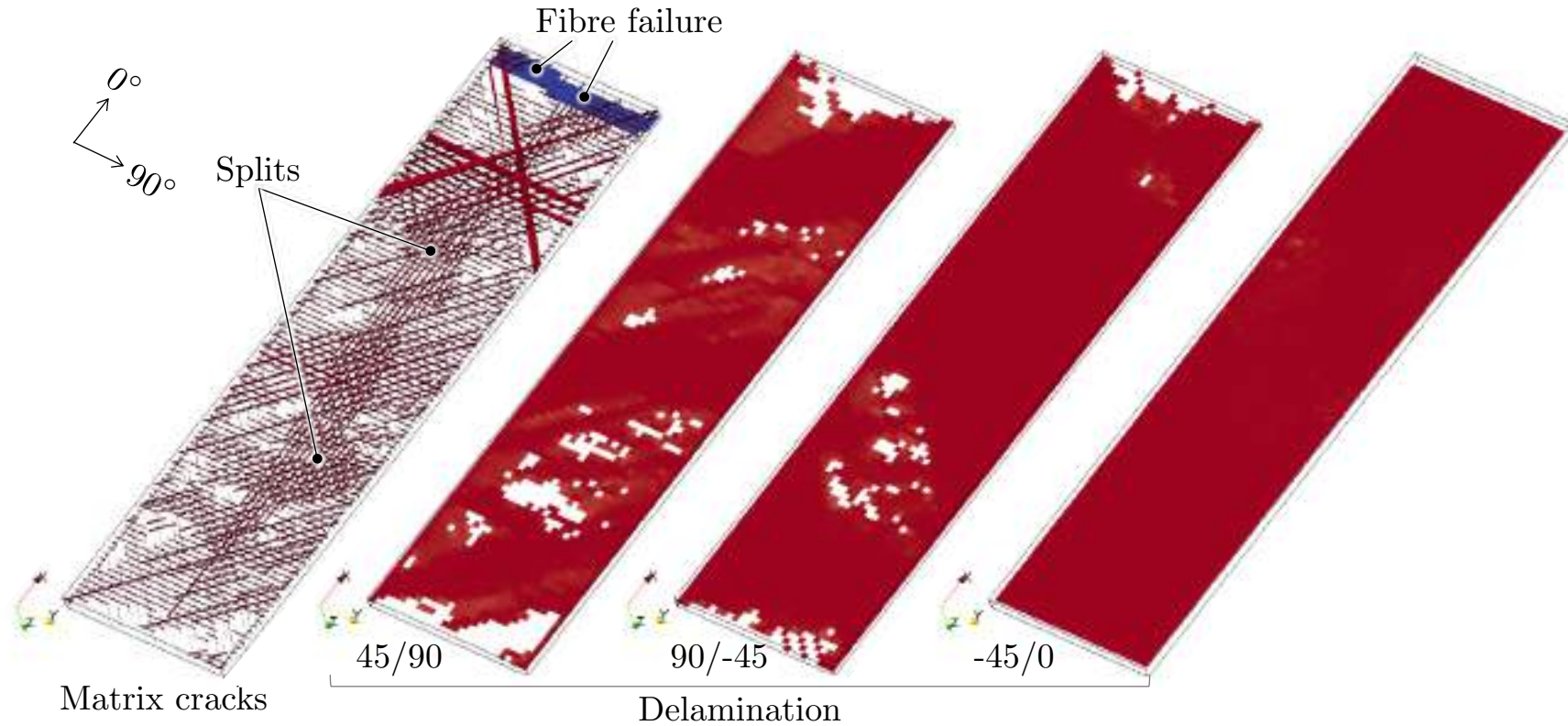
Un-notched Tension: Initial



Un-notched Tension: Mid



Un-notched Tension: Final





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